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Original Article

Feasibility and Acceptability of Workers' Health Surveillance for Fire Fighters

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Objectives: The objective of this study was to test the feasibility and acceptability of a new workers' health surveillance (WHS) for fire fighters in a Dutch pilot-implementation project.
Methods: In three fire departments, between November 2007 and February 2009, feasibility was tested with respect to *i)* worker intent to change health and behavior; *ii)* the quality of instructions for testing teams; *iii)* the planned procedure in the field; and *iv)* future WHS organisation. Acceptability involved *i)* satisfaction with WHS and *ii)* verification of the job-specificity of the content of two physical tests of WHS. Fire fighters were surveyed after completing WHS, three testing teams were interviewed, and the content of the two tests was studied by experts.
Results: Feasibility: nearly all of the 275 fire fighters intended to improve their health when recommended by the occupational physician. The testing teams found the instructions to be clear, and they were mostly positive about the organisation of WHS. Acceptability: the fire fighters rated WHS at eight points (out of a maximum of ten). The experts also reached a consensus about the optimal job-specific content of the future functional physical tests.
Conclusion: Overall, it is feasible and acceptable to implement WHS in a definitive form in the Dutch fire-fighting sector.

Key Words: Feasibility studies, Occupational health

Introduction

Health surveillance was originally used for detecting health problems such as epidemics, and identifying potential factors involved in disease occurrence [1]. Foege et al. [2] recommended that action should follow after data collection and data interpretation in public health surveillance. In the case of workers' health surveillance (WHS), the protection of workers' health (physical, mental and social well-being) at the individual and group levels should be the main goal [3]. More specifically, the goal of a WHS is to detect adverse health effects resulting from occupational exposure at the earliest stage possible so that appropriate preventive measures can be instituted promptly [4].

Mandatory medical examinations for fire fighters are required by law in the USA (NFPA 1582, 1997), as well as in the Netherlands [5]. The purpose of the medical examination for fitness-for-duty tests is, as described by Cox et al. [6], "to make sure that an individual is fit to perform the task involved effectively and without risk to their own or others' health and safety." An example of a mandatory fitness-for-duty test is the Canadian test developed by Deakin, with representative tasks for fire fighters [7]. In addition to this mandatory test, WHS programs exist. In 1998, the International Labour Office recommended that, for worldwide use of WHS, it should be linked to the surveillance of occupational hazards present in the workplace. However, WHS can be mandatory or voluntary [3] and has different content and goals in different countries. Within the Netherlands, legislation has established that a WHS

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should be a reflection of the job. Furthermore, the detection of abnormalities should lead to appropriate action [8] by the occupational physician. Therefore, in the Netherlands interventions related to a job that are prompted by WHS results can be performed by the occupational physician as part of WHS procedures. The proposed WHS for Dutch fire fighters is a voluntary instrument. In countries where job-related interventions are not always a consequence of the results of WHS, separate health promotion programs have been described, also specific for fire fighters [9-11].

For fire fighters, a new WHS was developed due to the absence of one policy for occupational health care in the fire-fighting sector. The WHS was developed as the combined responsibility of the government, employers and unions [12]. Fire-fighting involves specific job demands: exposures to hazards in the job that cannot be prevented and may involve safety risks [13]. In jobs with specific job demands, a WHS is of special importance because the worker can be endangered. The possibility also exists that third parties (e.g., the public or colleagues) could be endangered if the occupational health requirements of the worker no longer fit the specific demands of the job. A new job-specific WHS for Dutch fire fighters was developed for two reasons. The first reason was different tests were used throughout the country for Dutch fire fighters until now, therefore a new nationwide WHS for fire fighters was necessary. The second reason was the introduction of new legislation, which stated that WHS should be based on the occupational health requirements that reflect the workload of the job [8]. For fire fighters, 12 occupational health requirements were described for the job (Table 1). When decreased work ability for the fire fighter is found with WHS, the occupational physician can give the fire fighter advice about the results and can start interventions to increase job-related health. For a description of WHS for fire fighters see Table 1. Before implementing WHS nationwide, the fire-fighting sector was advised to conduct a pilot-implementation study.

WHS held the same idea as was studied in health promotion programs, that stakeholders such as managers, union representatives and employees in the work environment should be involved when programs are implemented in the workplace [14-17]. If the stakeholders are not all involved in implementation studies, then it will be more difficult to implement new

Table 1. Content of WHS for fire fighters

WHS [12] for fire fighters was based on 12 occupational health requirements. The first six occupational health requirements can be summarised as physical health requirements and were tested in combination in two physical functional tests:
- Clambering and climbing
- Squatting, kneeling and/ or crawling
- Lifting
- Energetic load
- Back: bending positions and providing strength
- Working with the arms above shoulder height
The other six health requirements are:
- Sufficient sight
- Sufficient hearing
- Enhanced wakefulness and capacity to judge
- Ability to deal with peak emotional load
- Exposure of the skin to solid and liquid substances
- Exposure of airways/lungs to dust, smoke, gas or vapour.
In addition to those 12 health requirements, I) risk factors for cardiovascular diseases (the cycle ergometer is replaced by a cardiovascular disease risk factor guideline), and II) chronic diseases were admitted in WHS for fire fighters. All aspects were monitored with self-reports, a physical examination by a physician assistant and an occupational physician and the execution of two job-specific physical tests, judged by the testing team. After the execution of WHS, the occupational physician studied the results of the fire fighters and gave feedback individually in a face-to-face meeting. During this meeting, the occupational physician could begin or advise evidence based interventions if that was required by a WHS protocol. WHS is voluntary and fire fighters could voluntary comply to the advice of the occupational physician.

WHS: workers' health surveillance.

instruments in the field.

Rosen et al. [18] proposed a four-phase system for developing lifestyle interventions. For WHS, this analogy may hold as well: WHS should first go through a phase of determining feasibility and acceptability. Feasibility addresses whether or not an instrument can be implemented in practice [18], and acceptability concerns the opinions of stakeholders with regard to the new instrument [19]. In line with the ideas of Bowen et al. [19], when trying to implement this new WHS in the fire-fighting sector, fire fighters, testing teams, and management should be involved and asked for their opinions in order for the implementation to be successful. In addition, the content of the physical tests of WHS should be as job-specific as possible, and was therefore also assessed by experts from the sector. The opinions of several stakeholder groups were studied for later use in definitive implementation of this WHS. The aim of the present study was therefore to explore whether or not the new WHS for fire fighters is feasible and acceptable, by asking the involved stakeholders.

This study presents the process and results of the implementation of a new WHS. The study provides an overview of steps taken in the implementation process and of the involved stakeholders. The results of this implementation process may be valuable to researchers in occupational health care, as well as those in public health who are designing a process for implementation.

Materials and Methods

Participants and recruitment procedure

Three regional fire departments throughout the Netherlands selected with the help of the National Steering Group of the sector were involved in the study. In these fire departments, feasibility and acceptability were studied with three stakeholder groups: the fire fighters, testing teams judging WHS, and experts on the occupation of fire-fighting. A random sample of fire fighters in each of the three fire departments, taking into account sex, age and, status as a volunteer or professional, was invited to execute WHS after receiving information about the study. Oversampling of women and professionals was used to be able to compare subgroups in another part of the study. All fire fighters performed the same job tasks, such as fire-fighting, rescuing, and assisting at vehicle accidents. Those who were invited and agreed to participate sent back their informed consent or announced themselves by email or phone and filled out their informed consent in place of WHS. Fire fighters underwent and executed WHS. After passing all WHS tests, the participants were surveyed about the feasibility and acceptability of WHS.

In each fire department, testing teams were formed by the fire chief of the fire department. The testing teams included in total five fire-fighting sports instructors, six technical fire instructors, four occupational physicians, and five physician assistants. The testing teams conducted and judged the tests involved in WHS. The testing teams' evaluations of the feasibility of WHS took place in a subsequent interview. Additionally, a manager from each fire department and one fire chief of volunteer fire fighters was interviewed. Questions to the interviewees started with easy questions followed by more complex questions, as proposed by Britten [20]. The research team had expertise in occupational medicine, psychology, and human movement science, and in conducting interviews in occupational settings (e.g., other fire fighters, ambulance personnel). The research team developed the schedule of questions used in the interviews. The interviews were conducted by the first author (human movement scientist, present at all testing days during pilot-implementation, who knew all of the interviewees). The interviewer explained the purpose of the interview, that the interview was confidential, and asked for permission to audiotape the interview.

Experts on the occupation of fire-fighting were gathered through the participating fire departments and the national steering group of the sector for participation in the expert meeting. Fifteen experts responded to the invitation to the expert meeting. Those experts were fire-fighting sports instructors, technical fire instructors, occupational physicians, managers, union representatives, and one human resources employee. The experts participated in an expert meeting to verify the job-specific content of the two physical tests. The non-probabilistic sampling method, i.e. purposive sampling, was used to invite the experts [21]. The experts were invited on the basis of their knowledge about fire-fighting. The experts all had a background in fire-fighting, which increased the compatibility of the experts in the meeting, as recommended by Morgan [22]. The experts had differential knowledge from their own occupation, but with the same basic knowledge of fire-fighting, which facilitated conversations between the experts on the theme of the meeting [22]. The last author chaired the meeting.

The study was performed in accordance with the Declaration of Helsinki and was approved by the ethics committee of the Academic Medical Center. The data was collected between November 2007 and February 2009.

Feasibility

Feasibility addresses whether or not an instrument can be implemented in practice [18]. In this study, feasibility was op-

Table 2. Questions about feasibility for fire fighters after performance of WHS and for testing teams

Feasibility: written questions for fire fighters after performance of WHS	Intention to change	- Did WHS provide you with better insight into your own health situation?
		- Do you intend to improve your own health if the occupational physician advises you to do so?
Feasibility: questions used in testing teams	Instructions around WHS	- What is your opinion about the information you got about how to perform WHS?
		- Were your responsibilities for performing WHS clear from the information you were given?
		- Were you able to test the fire fighters as described in WHS protocol?
	Procedure in the field	- What is your opinion about the logistics applied surrounding WHS?
		- Was it possible to administer WHS with the chosen procedure?
	Future organisation	- What do you believe are the success factors for the implementation of this WHS?
		- What do you believe are the potential obstacles for the implementation of this WHS?

WHS: workers' health surveillance.

erationalized by four concepts: *i)* worker intent to change their own health and behavior; *ii)* quality of the testing team instructions; *iii)* the planned procedure in the field; and *iv)* organization of a future nationwide WHS.

i) The first concept was part of feasibility because job-related interventions for changing health and behavior, as a result of the tests, are part of WHS in the Netherlands. Therefore, the fire fighters filled out an evaluation form after performing WHS. This form contained two questions with yes/no responses concerning their own intentions to change their health behavior, if that turned out to be necessary given the results of WHS (Table 2). *ii)* The second concept of feasibility, quality of the testing team instructions, is part of feasibility due to the essential and critical role of the testing teams in the future execution of WHS. *iii)* For the planned procedure in the field, the third concept, we investigated whether or not the logistics were feasible. *iv)* For the fourth concept of feasibility, we investigated the organization of a future nationwide WHS by looking at the success factors and potential obstacles.

Concepts *iii* and *iv* are necessary for eventual adaptations of future implementation and therefore part of feasibility. To investigate points *ii* through *iv*, testing teams participated in a structured interview in their respective fire departments after the pilot-implementation period. In some of the testing teams, multiple persons filled the same role and were interviewed together. Consequently, 16 interviews were conducted. Table 2 shows the open-ended interview questions regarding the instructions they received for conducting WHS, the procedures used in the field and the future organisation of the nationwide WHS. The instructions for conducting WHS included a written testing protocol, the researchers provided training for the testing teams on how to conduct WHS, and all testing teams observed a demonstration of the complete WHS procedure when it was performed in the first department. The interviews with the managers focused on the future nationwide organisation of WHS.

Acceptability

Acceptability concerns the opinions of stakeholders about the new instrument [19] and was assessed in two ways: *i)* satisfaction with WHS and *ii)* verification of the job-specific content of the new physical tests that was included to test the physical health requirements.

Because the opinion of the fire fighters is of importance for accepting WHS, for the first aspect of acceptability the fire fighters answered four questions about their satisfaction with WHS in their survey (Table 3). They were asked to provide ratings between 0 (very bad) and 10 (very good).

In addition, the opinion of fire fighter experts about the job-specificity of the two functional physical tests is essential for implementation with sufficient acceptability. Therefore, 15 experts verified the job-specificity of the content of the two physical tests of WHS by giving their opinions on the job-specificity of those physical tests during the expert meeting (for the content of the two tests see Table 4). The expert meeting was organized, first, to reach consensus about every part of the fire-fighting simulation test and, second, to determine whether or not these parts of the test reflect the real intensity and demands of on-the-job activities. These aims were explained to the experts. The experts voted on several statements electroni-

Table 3. Questions about acceptability to fire fighters in the evaluation form after performing WHS

Acceptability	Satisfaction with WHS	- How satisfied are you with the tests' execution by the testing team?
		- How satisfied are you with the way you were informed before the test?
		- How much do you appreciate WHS?
		- How much will you appreciate it in the future, when this surveillance is offered once every couple of years by your employer?

WHS: workers' health surveillance.

Table 4. Description of physical tests evaluated for acceptability as part of WHS

Test 1: Fire-fighting simulation test
The fire-fighting simulation test is a simulation of several fire-fighting activities divided into 12 parts [7,23]. Fire fighters were asked to perform the test as quickly as possible. Reproducibility and validity are described [24].
1) Donning turnout gear
Subject is waiting in station clothes (shirt and pants) for the starting sign. After the starting sign, participants put on standard fire fighter turnout gear and boots and walk 15 meters to point two.
2) Attaching SCBA , putting on gloves and carrying two hoses
Attaching the SCBA and mask, which are ready at a fire engine (or simulation platform) at the number 1 position. Putting on gloves, then taking two 52-mm hoses and walking 15 meters to point three.
3) Throwing, coupling and dragging hoses
Putting down one hose, throwing the second hose to a point 15 meters ahead, taking the connection of one hose, and afterwards walking to the end with one end of the hose. Coupling two hoses and walking with one end of the hose to the starting point of point three, then walking 17 meters to point four.
4) Setting up ladder, climbing ladder three times to the 10th rung with fire-fighting gear
Ladder stands straight up against the wall, putting ladder in a good position, and sliding to the tenth rung which was marked. Twisting the rope around the third and fifth rung and making a knot at the fourth rung. Taking the toolbox from the fire engine, line and spout. Walking back to the ladder and climbing up to the tenth rung and back down with the fire-fighting gear, one after the other. Walking 15 meters to point five.
5) Connecting SCBA and forcible entry, simulating hitting resistance
Walking from point five to the fire engine (15 m), taking the sledgehammer there, and walking back to point five. Reading and announcing the amount of air, connecting the SCBA, and hitting with the sledge hammer against the resistance. Moving the resistance a distance of 30 cm, as determined by the instructor. Walking 15 meters to point six.
6) Dragging hose, filled with water
A 75-mm hose, half-filled with water and ending with a spout, lies in a zigzag arrangement near the fire engine. Taking hose over shoulder and stretching it forward 15 meters to the end. Afterwards walking 19 meters to point seven.
7) Rescuing dummy
Picking up the dummy, according to Rautek, and dragging the 80 kg dummy 15 meters backwards, then turning around and walking another 15 meters backwards to the starting point. Attention is paid to the manner of exertion from the legs, with a straightened back. Walking 15 m to point eight.
8) Walking a balance beam
Four beams lie in a zigzag pattern. Walking over a balance beam. Must start over after a fall. Walking 15 m to point nine.
9) Hose-dragging simulation
Dragging hoses 15 meters, two times. The apparatus simulates dragging a hose. First, 15 meters dragging, walking around a counter, and then an additional 15 meters dragging. Walking 15 m to point ten.

Table 4. Continued

10) Stepping/climbing over a fence
Stepping/climbing over a fence 1.03 m in height (not jumping) and walking 15 m to point eleven.
11) Smoke dive simulation with hose, standing and squatting
Taking a high-pressure hose forwards and backwards over 15 meters: 3 meters walking forward, 3 meters under tunnel (height 1.20 m) while walking squatted, 3 meters normally, 3 meters under tunnel squatted and 3 meters normally, all forwards and subsequently backwards. Walking 13 m to the last component, twelve.
12) Ceiling demolition simulation
Simulating demolishing a ceiling by knocking a heavy ball hanging out of the ceiling, with a massive bar. The ball must touch the top of the basket ten times. The instructor counts aloud.
Test 2: Fire-fighting stair-climb test
The fire-fighting stair-climb test [25,26] assessed whether someone is able to come to an energetic peak load within a short time, a functional way of moving for fire fighters. The fire fighters were asked to climb the stairs as quickly as possible while wearing turnout clothes and with their SCBA connected. While climbing the stairs they carried 20 kg of fire-fighting-related materials, such as a hose and a toolbox. Dutch law requires that a building with a floor higher than 20 meters should have a fire fighter elevator (Bouwbesluit 2003/ Construction order 2003). Therefore, real-life fire-fighting tasks include climbing stairs up to 20 meters. Consequently, fire fighters climbed a distance of 20 meters in the stair-climb test. Depending on the step heights in the different fire departments, this distance contained between 108 and 117 steps. A sports instructor affiliated with the fire department timed this test and noted it, together with the end heart rate, on a form. The reproducibility and validity are described [27].

WHS: workers' health surveillance, SCBA: self-contained breathing apparatus.

cally using an interactive group response system (TurningPoint 2008, OH, USA). Statements with several answer possibilities were presented in a Microsoft PowerPoint presentation. The experts voted by pressing a number on a response device. The procedure followed was: the statement was shown; experts voted; the results of the voting were provided; the opinions of the researchers were provided; the experts had the opportunity to present arguments for or against the statement; and final votes were given and recorded.

Data analyses

The relative frequencies (%) were calculated for the questions asked to the fire fighters about feasibility. All interviews with the testing teams and involved management were recorded and transcribed verbatim [20]. Then each transcript was read by the research team and relevant information for each question was extracted. As the questions were rather concrete, analyses involved summarizing the results of the interviews. The summaries were discussed by the research team. Major points of the testing teams' responses to the questions were gathered by consensus of the research team and are presented.

For the fire fighter questions relevant to test acceptability, the median and interquartile range were calculated with SPSS version 16.0 (SPSS Inc., Chicago, IL, USA). In addition, proportions of satisfactory (6 or higher) and unsatisfactory marks (< 6) were calculated. From the expert meeting, consensus was defined a priori (and communicated as such with the experts) as shared opinion among at least 66.6% of the experts. That opinion was adopted by the researchers for implementation advice to be given to the sector. From the expert meeting, the consensus reached by the experts was calculated in terms of relative frequencies (%) for each statement and then described.

Results

A total of 275 fire fighters from among the 1,100 invited participated in WHS. The sample included 16% women and 84% men; 51% professionals and 49% volunteers. The age breakdown was as follows: 22% were ≤ 29 years; 34% 30-39 years; 32% 40-49 years; 12% ≥ 50 years.

Feasibility

Nearly two-thirds of the fire fighters (63%) reported gaining insight into their own health after performing WHS and 246 out of 262 (94%) fire fighters reported the intention to improve their health when recommended by the occupational physician after their WHS (Table 5).

The testing teams evaluated the instructions as positive. Approximately 70% of the interviewees from the testing teams were positive about the structure of the tests, but felt that the test locations should be as close as possible. It was possible to conduct WHS using these procedures, although substantial

Table 5. Answers of 275 fire fighters to evaluation questions about feasibility after executing WHS

Feasibility questions	Yes/no (n)	Yes/no (%)
Insight into own health (n=271)	171/100	63/37
Intention to improve health when advised (n=262)	246/16	94/6

WHS: workers' health surveillance.

Table 6. Ratings given by 275 fire fighters after executing WHS

Acceptability questions	Median (interquartile)	Satisfied/ Unsatisfied %
Satisfied with the test's execution (n=275)	8.0 (1.0)	99.6/0.4
Satisfied with the information given in advance (n=275)	8.0 (1.0)	96.3/4.7
Rating of WHS (n=275)	8.0 (1.0)	97.5/2.5
Appreciation of the future offering of WHS (n=274)	8.0 (2.0)	96.4/3.6

WHS: workers' health surveillance.

time and effort needed to be invested in the initial organisation.

Success factors for future implementation of WHS were observed in the job-specific content of the physical tests. The cycle-ergometer test with ECG was not included in the new WHS and the occupational physicians felt that this test was lacking. Furthermore, the labor-intensive nature of WHS was judged as a potential obstacle to its implementation. The perceived effort of the physical tests could be seen as a threat to women and volunteer fire fighters, but this is left for future studies to determine.

Acceptability

Over 95% of the fire fighters appreciated WHS, were satisfied by its execution and the information they received in advance, and would appreciate this WHS if it was offered by their employers in the future. The fire fighters gave WHS an average rating of 8 on a scale from 0 to 10, as can be seen in Table 6. These are the answers to the questions as reported in Table 3.

Consensus among the 15 experts about the job-specific content of the physical tests was reached in 18 out of the 23 statements (Table 7). The opinion of the experts was that the work-load demanded in both physical tests was comparable to the on-the-job work-load experienced during fire-fighting activities. In cases where no consensus was reached, ideas for future changes were generated by the experts.

Discussion

In this pilot-implementation study, job-specific WHS for fire fighters was evaluated in terms of feasibility and acceptability. Three stakeholder groups - fire fighters, testing teams, and fire-fighting experts - were studied. As part of the investigation of feasibility, almost all fire fighters reported the intention to improve their health if advised to do so by an occupational physician. The instructions on how to conduct WHS were clear and the procedure for conducting WHS in the field was confirmed, reinforcing its feasibility. WHS was concluded to be acceptable because fire fighters rated their appreciation of the utility of WHS on average as eight points out of ten. A panel of experts reached a consensus that the content of the physical functional tests of WHS was job-specific.

In the present study, the feasibility and acceptability of one WHS were studied among stakeholders that will be most involved when it is implemented in the future [19]. Consequently, in the present study, feasibility was studied with fire fighters and testing teams, and acceptability was studied with fire fighters and with fire-fighting experts. Feasibility and acceptability were studied separately in this study, as described by Rosen et al. [18]. We think it is important to study both feasibility and acceptability during pilot implementation. If only one of these concepts is studied, e.g., feasibility, then the results only show whether it is practically feasible to implement the instrument, without providing any information on the opinions of the stakeholders who will work with the instrument in the future. When both concepts are studied with positive results, as in the present study, there is more potential for WHS to be implemented successfully in the future.

The dichotomous scale might have forced participants into one of the extremes whether they would have the intention to change behavior or not, if it was advised by the occupational physician, while the real answer was somewhere in-between, or dependent on which aspect the occupational physician would have given advice. The dichotomous scale was a considered choice, since in a pilot study doubtful answers don't give a direction for the definitive implementation.

In the interviews conducted for the feasibility segment of this study, it became clear that the occupational physicians felt that the cycle ergometer test in this WHS was lacking, because they were used to the cycle-ergometer test in WHS for fire fighters. However, the idea of this WHS was to test exposures and activities of the job in a job-specific way. As cycling is not job-specific for fire fighters, it was not used in this WHS. WHS

Table 7. Opinions of 15 experts about parts of the fire-fighting simulation test and fire-fighting stair-climb test as percentages (consensus ≥ 66.6%). [ ] is no consensus

Test section	% consensus
1) Preparing for turnout, putting on fire fighter turnout gear.	
This part executing as part of the test.	100
2) Attaching SCBA in the fire engine, putting on gloves, getting out of the fire engine and carrying two hoses.	
Within one of the departments, a platform was used in place of a fire engine, which was a good representation of what will be used throughout the country.	[57]
3) Throwing one hose, walking, throwing the second hose, coupling hoses and dragging the hose.	
The 52-mm hose is the most suitable hose to use in this part of the test.	69
4) Setting up a ladder, climbing the ladder three times while carrying fire-fighting gear.	
a) Setting up a ladder happens in real situations.	100
b) It is suitable to climb the ladder.	100
c) When climbing, take the toolbox, line and spout.	93
5) Connecting the breathing apparatus and forcible entry simulation, hitting resistance.	
a) Hitting with the sledge hammer against the resistance is a valid simulation of a real situation in which a door has to be entered.	[60]
b) There should be variation in height of the resistance, when simulating entering a door.	78
6) Dragging a hose filled with water.	
This part is a valid simulation of the job.	100
7) Rescuing a dummy.	
a) In this part of the test dragging a colleague was simulated.	[63]
b) The best way of dragging the dummy is by having it in a grip according to Rautek.	[56]
c) The distance the dummy must be dragged, 30 meters, is not realistic.	78
8) Walking a balance beam.	
Fire fighters at times have to keep their balance, with nothing in their hands.	90
9) Hose dragging simulation.	
a) This part is the right simulation of the physical movement of dragging a hose.	75
b) The weight (80 kg) that is repeatedly pulled is too heavy.	[56]
c) The distance across which the weight is pulled, 2 x 15 meters, is too long.	71
10) Stepping/climbing over a fence.	
a) The fence height of 1.03 meters is a realistic height for an obstacle.	78
b) One instance of climbing over the fence is not sufficient.	75
11) Smoke dive simulation with a hose, in both the standing and squatting positions.	
The distance covered, 2 x 3 m forwards and 2 x 3 m backwards, can be expected in practice.	90
12) Ceiling demolition simulation.	
a) It is necessary to be able to act precisely in fire-fighting, during/after fatigue.	86
b) The demolition activities are a realistic test of actual fire-fighting activities.	92

Table 7. Continued

Test section	% consensus
I) Total workload	
The fire-fighting simulation test is a 'pressure cooker' of all fire-fighting activities. The weight of the total fire-fighting simulation test (if all parts are realistic reflections) is so realistic that it can be expected that well-functioning fire fighters who carry out operative tasks can execute the test in the current form.	100
II) Peak workload - fire-fighting stair-climb test	
Providing peak energetic load is a specific occupational health requirement. To test in a functional manner if somebody is able to provide a peak load, the fire-fighting stair-climb test is introduced. The effort that is required in the fire-fighting stair-climb test is a good reflection of the peak load that can be demanded in practice.	92

SCBA: self-contained breathing apparatus.

is developed to monitor worker health in order to protect the worker. During the pilot-implementation, the instrument was a voluntary tool, while after the study the sector decided to make it a mandatory fitness-for-duty test. The voluntary character of the test at the time of the study might have influenced the results, as workers might have made another judgment if WHS was already the mandatory test. The moment of this pilot-implementation was the situation as questioned in this study, therefore we think this study correctly represents the opinions of the stakeholders.

Study limitations

All stakeholders evaluated WHS mostly positively. In particular, the fire fighters gave rather high values in their evaluations. As suggested in an implementation study by Grol and Jones [28], it is possible with implementation studies that those most willing and ready to change, the "early adopters," are most often included in implementation studies. That could be a limitation of our study, because a random sample of fire fighters from three fire departments were invited to participate in this study. Perhaps the fire fighters who agreed to participate were already willing to change and thus their evaluations were more positive. Although these fire fighters were perhaps early adopters, critical suggestions were made by these fire fighters that will be useful for future implementation of WHS. Fire fighters are not the implementers of this surveillance, but early adopters may help with the implementation process throughout the country by providing information on sessions with other fire fighters who have not yet performed WHS.

Finally, 275 fire fighters participated and more than 95% of 275 participants gave a positive response to WHS. The response rate of the fire fighters was about one in four. As authors, we realize that such a response rate does not represent an ideal situation. Nevertheless, the characteristics of the fire fighters who did respond varied; fire fighters of all age categories, volunteer and professional, male and female participated and therefore, the results are of value for future implementation of this WHS in the Dutch fire-fighting sector.

Future implications

In line with current ideas about the implementation of other instruments in the work setting [17,19], several stakeholders were used in this study to test feasibility and acceptability. As a result, the ideas of all stakeholder groups became clear and were incorporated into the advice provided to the sector on how to implement the final WHS in a feasible and acceptable manner nationwide.

The advice given to the fire-fighting sector was to keep using the same materials and verbal instructions and to use fire fighters with positive experiences as ambassadors in the nationwide implementation of WHS. Furthermore, it was recommended to use national, rather than regional, test centers in nationwide implementation. For some parts of the fire-fighting simulation test, small adaptations were recommended by the experts at the meeting. The first piece of advice for adaptation of the physical test was to use a platform to simulate a fire engine and to make sure that all varieties of SCBA holders used in the country can be used on the platform. Second, it was advised to vary the height of the resistance when simulating entering a door. Third, fire fighters should rescue a dummy (80 kg) by dragging it in any grip for a distance shorter than 30 m, over obstructions. Fourth, the hose-dragging simulation must be adapted to a job-specific simulation with regard to weight and length to better match situations encountered on the job. And fifth, fire fighters must climb twice over the fence rather than once.

It will be feasible and acceptable to implement this WHS in the fire-fighting sector in the future with confirmed job-specific content for the physical tests, keeping the aforementioned points in mind. However, before implementing WHS, future

research should focus on other phases, as proposed by Rosen et al. [18]. Many fire fighters (94%) reported the intention to improve health when advised by the occupational physician, therefore it should be determined whether or not job-related interventions result in altered behavior and in better work ability among fire fighters.

In conclusion, the new WHS was found to be feasible and acceptable by fire fighters and testing teams. Experts reached a consensus about the job-specific content of most parts of the physical tests of WHS. From this study, it can be concluded that the job-specific WHS for Dutch fire fighters can be implemented, with minor adaptations suggested by the experts.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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